
Space Weather Technical Forecast

Issued on Tuesday, 21 June 2022 at 12:59 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Active electron fluence expected on Day 1 (21st). Daily Chance of an isolated M-class flare.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional C-class flares. There are presently six numbered sunspot regions on the visible disc. The largest and most complex region remains AR3038 (Eki/Beta-Gamma) transiting across the northwestern quadrant. This region has continued to mature, becoming more elongated whilst retaining reasonably large leading and trailing spots, with some further minor intermediate spot emergence. AR3035 (Bxo/Beta) has shown some recent weak spot emergence, otherwise the other numbered regions have remained largely unchanged. A newly numbered region, AR3040, is beginning to transit around the southeast limb, and has tentatively been assigned an Hsx/Alpha.

No Earth directed CMEs (Coronal Mass Ejections) were observed on available imagery. Faint, narrow ejecta was observed following a C2 flare from AR3034 at 20/2355 UTC, directed mostly to the south and west, with a rather slow movement. This was modelled with no impacts expected.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, decreased gradually, although a little erratically from around 550-630 km/s to 450-520 km/s. Its density was largely average but two brief peaks were observed to around 30 ppcc and 20 ppcc near 20/1400 UTC and 21/0900 UTC. The IMF was generally weak 3-7 nT, with Bz varying between +4 and -6nT. The phi angle was mostly positive (away from the Sun), but with negative orientation (towards the Sun) between from 20/1300-1800 UTC, and after 21/0900 UTC. Geomagnetic activity was occasionally Unsettled (Kp 3) before midnight UTC, otherwise Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured by GOES16 remained at background levels through the period. Electron flux (greater than 2MeV) was generally at Moderate to High levels in the period, with a peak of 2970pfu observed at GOES16 at 20/1450 UTC. The corresponding 24-hour integrated electron fluence was above the Active threshold ($>1e8$ integrated pfu) through much of the period, reaching a peak of $1.26e8$ integrated pfu at 20/1800 UTC, but is on a slow downward trend. Observed fluence was $1.08e8$ integrated pfu at 21/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low, with a daily chance of an isolated M-class flare and very slight chance of an X-flare.

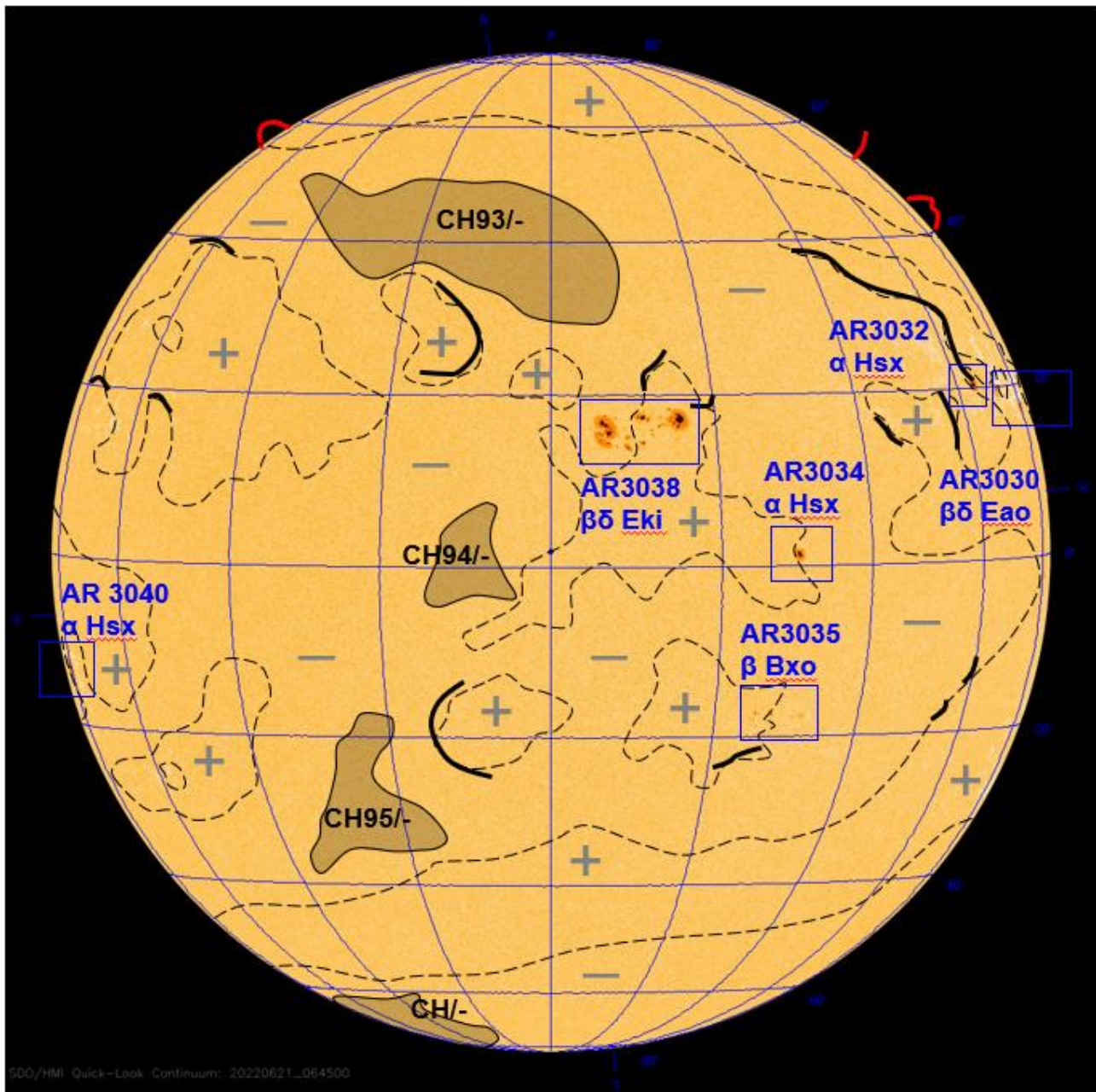
Solar Wind / Geomagnetic Activity: No CMEs currently feature in the forecast.

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Solar winds should continue their initial decline and return towards slow-ambient levels by Day 3. They are expected to become slightly elevated to elevated during Day 4, under the influence of a coronal hole HSS (CH93/-). Geomagnetic activity should be mostly Quiet with perhaps the odd Unsettled interval through much of the period, but become Unsettled to Active with a slight chance of a G1/Minor storm during Day 4 (24th).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at Background levels during the period, but with a daily Slight Chance of an S1 or greater event. The high energy electron flux (greater than 2 MeV) is expected to gradually decline to Background to Moderate levels by Day 3, and perhaps Day 4. The associated 24-hour integrated fluence is expected to remain close to the Active threshold on Day 1 (21st) and perhaps Day 2 (22nd), before dropping below Active levels

Figure 1. Solar Analysis Valid 21/0700 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No CMEs currently feature in the forecast.

The Earth briefly encountered the fast speed stream of a negative coronal hole on the 20th. With no obvious signs of any significant coronal holes on the western hemisphere, solar winds should continue their initial decline and return towards slow-ambient levels by Day 3, as suggested by the Met Office persistence model. The next coronal hole likely to affect Earth is CH93/-, currently approaching the central meridian in the north. Despite being a recurrent feature, it has considerably slowed down compared to the previous rotation and is not expected to be in a geo-effective location until Day 4. The persistence model is a little quick for its arrival.

With this in mind, geomagnetic activity should be mostly Quiet with perhaps the odd Unsettled interval through much of the period, but become Unsettled to Active with a slight chance of a G1/Minor storm during Day 4 (24th).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None expected.

Radio Blackouts - X-Ray Flares:

There are six numbered sunspot regions on the visible disc at present. The largest and most complex region remains AR3038 (Eki/Beta-Gamma) transiting across the northwestern quadrant. This region has continued to mature, becoming more elongated whilst retaining reasonably large leading and trailing spots, with some further minor intermediate spot emergence. AR3035 (Bxo/Beta) has shown some recent weak spot emergence, otherwise the other numbered regions have remained largely unchanged. A newly numbered region, AR3040, is beginning to transit around the southeast limb, and has tentatively been assigned an Hsx/Alpha.

Solar activity has been Low over the past 24 hours, with occasional C-class flares. Activity is likely to continue at Low levels, with a chance of an isolated M-class flare, and slight chance of an X-flare, most likely from AR3038.

The moderately large filament in the northwest quadrant is stable at present but will be monitored for any potential lift-off. Some further bright flux regions are also visible on STEREO A EUVI195 imagery, around 110 degrees East, suggesting the presence of sunspots regions. These could potentially emerge from the far side over the following days, leading to a readjustment of the probabilities.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels and is expected to remain at this level through the period. However, there is a slight chance of an S1 or greater event through the next four days as AR3038 rotates across the western disc. This region is relatively large, complex with some further development. As such, it carries a slightly elevated risk of solar radiation storm.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV), as observed by GOES16, rose to high levels, peaking at 2970 ppcc at 20/1450 UTC, the radiation belts becoming charged following the HSS originating from CH90 and CH92. This pattern should continue on Day 1 and perhaps Day 2, with the electron flux becoming high during the diurnal peak, although with a likely declining trend. Day 3, and perhaps Day 4 should see flux levels at Background to Moderate.

The associated 24-hour integrated fluence is expected to be close to the Active threshold on Day 1 (21st) and perhaps Day 2 (22nd), before dropping below Active levels. The REFM output is not considered to provide good guidance for Days 3 and 4, the forecast considered too high. However, it looks good guidance for the next 24 hours. The corresponding recurrence looks too low but with a good overall trend to Day 3.

GEO Electron Environment	Level (cm ⁻² sr ⁻¹ day ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1x10 ⁸	Yes	99	70	40	40
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	10	10	5	1

Figure 2: MOSWOC REFM latest output. Observations (blue dots), Forecast (white dots), Recurrence (Yellow dots)

